UNIVERSITI PUTRA MALAYSIA

DEVELOPMENT OF A KNOWLEDGE·BASED COMPLIANCE AUDITING SYSTEM FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROJECTS IN MALAYSIA

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DEVELOPMENT OF A KNOWLEDGE-BASED COMPLIANCE AUDITING SYSTEM FOR ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROJECTS IN MALAYSIA

By

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Thesis Submitted in Fulfilment of the Requirement for the Degree of Doctor of Philosophy in the Faculty of Engineering Universiti Putra Malaysia

January 2001

DEDICATED TO MY

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

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Environmental Management Program (EMP) constitute an important component of the Environmental Impact Assessment (EIA) report of the development projects where the environmental monitoring programs and the environmental compliance auditing (ECA) aspects should be described in detail. ECA requires systematic selection of monitoring variables and analysis of the monitoring database and also requires that a uniform quality standard in auditing be maintained for different types of development projects and different stages of their development. ECA should produce an audit report that is easy to understand and could be used undertaking mitigation measures. Presently, in Malaysia, for the EIA projects, there is neither any specific guideline for conducting compliance auditing nor any systematic management of the data generated through monitoring of the projects.

The main objective of this study is to develop a knowledge-based environmental compliance auditing system (called ECA-KB) that uses expert's knowledge from different environmental fields and a quantitative technique of

evaluating the environmental compliance level of a particular project. ECA-KB comprises of three components namely monitoring database system, compliance auditing model, and knowledge base system. These three component systems have been integrated together to produce concise and comprehensive environmental compliance audit report for the EIA projects.

The study provides a tool for the decision-makers and the stakeholders namely the project proponents, environmental consultants, and Department of Environment (DOE) to monitor, evaluate environmental compliance level of the projects, generate compliance audit report, and to keep track on the compliance trend. The great potentiality of the developed ECA-KB is that it is produced in easy interactive and simplified manner that can be run as desktop applications by both the experts and the non-expert users. The system is available in installable CD's and can be reached to the potential users by several ways including distribution of CD's through market channel, demonstration in the seminars, and symposium.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk Doktor Falsafah

PEMBANGUNAN SISTEM AUDIT PEMATUHAN BERDASARKAN KEPAKARAN UNTUK PROJEK PENILAIAN KESAN ALAM SEKELILING (EIA) DI MALAYSIA

Oleh

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Program Pengurusan Alam Sekitar (EMP) adalah komponen penting dalam Penilaian Kesan Alam Sekitar (EIA) bagi projek pembangunan dimana aspek Program Pemonitoran Alam Sekitar dan Audit Pematuhan Alam Sekitar (ECA) perlu dihuraikan secara terperinci. ECA memerlukan pemilihan pemonitoran pembolehubah dan analisis pemonitoran pengkalan data yang sistematik dan juga memerlukan satu standart yang seragam untuk dilaksanakan dalam pengauditan untuk projek pembangunan yang berlainan pada peringkat yang berbeza semasa pembangunan. ECA boleh menghasilkan laporan audit yang mudah difahami yang boleh digunakan untuk proses mitigasi. Buat masa ini, di Malaysia, tidak terdapat sebarang garis panduan yang spesifik untuk melaksanakan audit pematuhan atau pengurusan yang sistematik untuk projek EIA bagi data yang dihasilkan melalui pemonitoran projek.

Tujuan utama kajian ini adalah untuk menghasilkan Sistem Pematuhan Audit Alam Sekitar berdasarkan pengetahuan (ECA-KB) yang menggunakan pengetahuan pakar dari bidang yang berlainan dan teknik kauntitatif dalam menilai tahap pematuhan alam sekitar bagi sesuatu projek. ECA-KB terbahagi kepada tiga

komponen iaitu, Sistem Pengkalan Data Pemonitoran, Model Audit Pematuhan dan Sistem Berdasarkan Kepakaran. Ketiga-tiga komponen ini telah digabungkan bersama dengan pengaturcaraan komputer dan berupaya untuk berfungsi secara berkesan untuk menghasilkan laporan projek EIA.

Keputusan kajian ini memberikan pilihan kepada para pembuat keputusan serta pengusaha projek atau JAS, untuk mengawas, menilaian tahap pematuhan alam sekitar sesuatu projek serta penghasilan laporan audit pematuhan dan seterusnya memastikan pematuhan dapat mengikuti aliran perubahan semasa. Potensi ECA-KB yang telah dihasilkan adalah, ianya interaktif dan dipermudahkan sehingga boleh dioperasikan dari mana-mana komputer oleh pakar dan bukan-pakar. Sistem ini boleh diperolehi dalam bentuk cakera padat (CD) dan boleh mencapai sasarannya melalui beberapa cara seperti penjualan, demonstrasi diseminar atau simposium.

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I certify that an Examination Committee met on 9th January 2001 to conduct the final examination of Md. Mizanur Rahman on his Doctor of Philosophy thesis entitled "Development of a Knowledge-Based Compliance Auditing System for Environmental Impact Assessment (EIA) Projects in Malaysia" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations that have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Putra Malaysia (UPM) or any other institution.

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LIST OF ABBREVIATIONS

AQI	Air Quality Index
BQI	Biological Quality Index
CAS	Compliance Auditing System
DOE	Department of Environment
EA	Environmental Auditing
ECA	Environmental Compliance Auditing
ECA-KB	Knowledge-based Environmental Compliance Auditing System
EIA	Environmental Impact Assessment
EQA	Environmental Quality Act
ES	Expert Systems
INWQS	Interim Water Quality Standards
IRM	Internal Resource Management
KBS	Knowledge Based System
MAQG	Malaysian Air Quality Guidelines
MDBMS	Monitoring Data Base Management System
NQI	Noise Quality Index
OEQI	Overall Environmental Quality Index
OMQI	Operational and Management Quality Index
SEQI	Socio-economic Quality Index
SQI	Soil Quality Index
USEPA	United States Environmental Protection Agency
VB	Visual Basic
WQI	Water Quality Index

CHAPTER I

INTRODUCTION

General Introduction

Physical development is necessary for economic growth and general well being of society in a country. However, such development normally brings changes in the environmental conditions in and around the development projects that could cause various short and long-term impacts on the environment. The environmental impacts could occur on the physico-chemical, biological, and socio-economic systems of the environment. The physico-chemical systems include the air, water, and soil; biological systems are the fauna and flora, and the socio-economic systems are the human and economic aspects of the environment.

In Malaysia, nineteen types of development activities have been identified as prescribed activities that require for the Environmental Impact Assessment (EIA) studies. These activities or projects include housing, resort, infrastructure, quarry, industry, waste disposal, petroleum, power generation, agriculture, mining, land reclamation, forestry, drainage, port, water supply, transportation, fishery, railway, and airport. In addition to EIA, a number of rules, and regulations have also been enforced with a view to control and regulate the adverse impacts of such development projects on the environment.

Environmental Impact Assessment (EIA) is a management tool used to identify the potential impact of physical development and subsequently to find out

the management and technical ways to reduce the environmental impacts (Canter, 1996; Ortolano and Shepherd, 1995).

Environmental Impact Assessment Guidelines introduced by Department of Environment (DOE) requires the project proponents to suggest an environmental management plan including a monitoring plan in their EIA report. The monitoring plan would provide qualitative and quantitative attributes of the environment that need to be monitored at regular interval and frequency while the project undergoes development and operation. The objective of the monitoring plan is to evaluate and assess the environmental performance of the project against the background environmental conditions and also to identify the areas where specific control measures are required. Monitoring of environmental conditions provides the necessary inputs for environmental compliance auditing and constitutes the integral part of the compliance auditing system (Fedra, 1997).

Environmental compliance audit is required to verify a project's compliance against the EIA approval conditions set by DOE to the project proponents and also against existing laws and regulations. The auditing process provides the management and control of the environmental practices of the project proponents through verifying the company's environmental policy, responsibilities, and organisation, risk management procedure, monitoring and reporting of environmental data (FAO, 1996).

Environmental compliance auditing system is a complex process because it requires the examination of multiple aspects of the environment. The project